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REQUIRED OPERATIONAL CAPABILITY (ROC) NUMBER INT 128
FOR A SMALL UNIT NAVIGATION SYSTEM(U) MARINE CORPS
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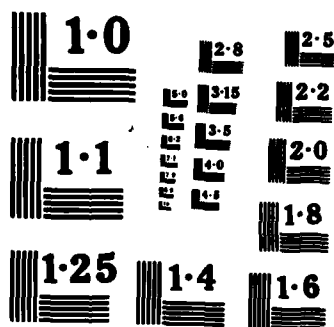
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From: Commandant of the Marine Corps

Subj: REQUIRED OPERATIONAL CAPABILITY (ROC) NO. INT 1.28 FOR A
SMALL UNIT NAVIGATION SYSTEM

Ref: (a) MCO 3900.4C

Encl: (1) ROC NO. INT 1.28 For a Small Unit Navigation System

1. This letter establishes ROC NO. INT 1.28 for a Small Unit Navigation System. The ROC has been developed in accordance with the reference and is contained in the enclosure.

2. The Commanding General, Marine Corps Development and Education Command (Director, Development Center) is the Marine Corps point of contact for the development efforts pertaining to the Small Unit Navigation System.

Distribution:

(See Attached)

Raymond Stuhli

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**PROPOSED REQUIRED OPERATIONAL CAPABILITY (ROC) FOR A
SMALL UNIT NAVIGATION SYSTEM (SUNS)**

1. STATEMENT OF THE REQUIREMENT. Marine Corps reconnaissance teams require a passive, highly durable miniaturized Navigational Star Global Positioning System (GPS) receiver capable of providing accurate, navigational information during long-range, clandestine reconnaissance missions. The SUNS will be utilized by reconnaissance personnel during Advance Force Operations and other long-range reconnaissance missions where the insertion modes, environmental conditions, and clandestine operational requirements preclude the use of other existing or envisioned navigation systems. With the current size and weight projections in the NAVSTAR GPS Manpack, it is possible that the SUNS could also be utilized to satisfy the Marine Corps GPS Manpack requirements. An Initial Operational Capability (IOC) of FY89 is required.

2. THREAT AND OPERATIONAL DEFICIENCY

a. Threat

(1) Soviet forces possess the capability to detect/discern the insertion/operation of enemy reconnaissance elements within their area of operations. Denial of enemy intelligence collection capabilities is integral to Soviet combined arms operations and includes counter-reconnaissance operations.

(2) Soviet denial of reconnaissance elements begins with the detection of its enemies' means of insertion. This detection includes both the support vehicles (i.e., aircraft, ship, submarine, etc.) that deliver the reconnaissance element to the location where the insertion starts, and the actual means of insertion. Detection is done by various manual and technical methods and focuses on a target's audio, radar, infrared (IR), visual, electromagnetic, and thermal signatures.

(3) Once reconnaissance elements are detected, active measures, such as air defense targeting, preplanned artillery, reaction forces, etc., are initiated to eliminate the intruding elements. If these initial responses fail to counter the reconnaissance activity, combat units supported by additional forces such as radio-electronic warfare teams are deployed to locate and destroy the reconnaissance elements. Soviet surveillance and target acquisition units in conjunction with radio-electronic forces and combat units continuously strive to detect and locate enemy reconnaissance forces.

(4) Potential enemy threats confronting the United States in the near-to-long-range period are described by the Marine Corps Long-Range Plan (MLRP), and the Marine Corps Mid-Range Objectives Plan (MMROP), FY82-91, Part II (Global and Regional Appraisals).

b. Operational Deficiency

(1) The threat described in paragraph 2a above has necessitated greatly increased stand-off distances for the support vehicles delivering and recovering reconnaissance teams in the objective areas. This increased stand-off distance requires the reconnaissance team to possess the capability to accurately navigate up to 100 miles to a point destination under conditions of reduced visibility, hostile environment, and poorly defined terrain features as found in desert, arctic, and tropical combat environments.

(2) Only NAVSTAR GPS Manpack receivers can meet the range, accuracy, and clandestine operating requirements of reconnaissance missions; however, the currently developed GPS Manpacks are too large and too heavy to be employed by the reconnaissance teams.

(3) Through exploitation of Very Large Scale Integration (VLSI) technologies, it is now possible to reduce the size, weight, and unit cost of the GPS receiver while retaining the essential operating characteristics to meet the SUNS requirements.

3. OPERATIONAL AND ORGANIZATIONAL CONCEPT

a. Operational Concept

(1) The SUNS will be utilized throughout a reconnaissance mission from insertion to extraction of the team. Insertions can be by a number of means to include high and/or low altitude parachuting, submerged submarine exits, inflatable boats, surface swimming, SCUBA, helicopter, ground vehicle or foot patrols. Mission durations may be from several hours to several weeks and may be Advance Force Operations or long-range unsupported patrols. Due to the threat to both the delivery vehicle and the reconnaissance team, precise navigation is paramount during the insertion and the extraction linkup. Since catastrophic destruction of the team and/or delivery vehicle is likely if detected/located by the enemy, poor environmental conditions such as darkness, foul weather, heavy cloud cover, rugged terrain, etc. are the desired operating conditions for the missions.

(2) Parachute insertions may require exiting an aircraft at night, at 30,000 feet above mean sea level (MSL), opening the parachute canopy and gliding up to 30 miles to the ground or water insertion point. Temperature extremes at 30,000 feet above MSL may reach -80° F. Worst case parachute opening shock may reach eight G's in a 1.0 second impulse; however, normal opening shock is four to 6 G's. The parachutist may be gliding under canopy for up to 40 minutes and may encounter multiple cloud layers as well as frosting/icing conditions. Teams will assemble in the air and attempt to maintain the formation during the entire descent. Night vision goggles will be utilized as well as oxygen equipment. As currently envisioned, only one member of the team will carry the SUNS for navigation; however, some missions may require a SUNS

for each team member. Simple, hands-off operation of the SUNS will be required during this insertion mode with the SUNS displaying at a minimum the steering direction, distance to target and elevation above MSL.

(3) Inflatable boat, surface swimmer, and SCUBA/underwater swimmer insertions and extractions require exiting or rendezvousing with a support vehicle during periods of reduced visibility and transiting distances from a few thousand meters to in excess of 60 miles from shore. These insertions may be made from submarines, surface vessels, helicopters or by parachuting from aircraft. Submarine operations may require embarkation in excess of several days prior to insertion, and it is not likely the submarine will surface while underway. Submarine lockouts may be made from depths of 120 feet; however, pressure-resistant vessels can be utilized to protect equipment from the water pressure at such depths. The SUNS is not required to operate below the surface; however, it must be capable of immersion in saltwater to a depth of 30 feet for up to two hours. Underwater swimmers may periodically surface long enough for the SUNS to get a position fix from the the satellites, then will submerge and continue on course. During inflatable boat insertions, speeds of up to 25 knots may be encountered, and the equipment must be capable of withstanding the shock and vibration experienced in such a boat in a sea state 3. Equipment and personnel are subjected to continuous salt spray and possible immersion due to capsizing, personnel swimming ashore, etc. Precise navigation is most critical when approaching landfall, penetrating a reef, or effecting a linkup with a recovery vehicle. Since visibility may be approaching zero due to darkness, fog, rain, etc., a navigational accuracy of 10 meters circular error probability (CEP) is desired with 50 meters circular error probability required.

(4) Helicopter insertions will likely be reduced visibility, low-level, terrain-following operations requiring the team to have a constant, accurate indication of its location both during the flight and immediately upon exiting the helicopter. (SUNS is not required to provide the in-flight location.) Helicopter extractions will also require low-level, terrain-following flights thus precluding the team from signaling the helicopter or directing it in from a distance. Precise position location reporting is required so the helicopter crew can select a route which will bring them to a precise extraction point without having to climb to altitude to receive a visual signal from the reconnaissance team.

(5) Ground vehicle insertions, extractions and patrols are conducted utilizing reduced-visibility and terrain-masking techniques in conjunction with detailed route planning. Night vision goggles are utilized, and continuous, accurate navigation is essential.

(6) Once the insertion is completed and the actual reconnaissance or surveillance task is being accomplished, only

periodic location updates are required. Teams may remain in one position for up to 18 hours and can be almost completely covered by soil, sand, snow, leaves, water, etc. during the entire time. Missions normally require movement only at night. Since the danger of capture or sudden catastrophic destruction of the team is always a possibility, a means of quickly zeroizing any programmed information in the SUNS may be necessary.

b. Organizational Concept. The SUNS will be employed by the force reconnaissance companies and the reconnaissance battalions of the FMF. Additionally, if the SUNS is utilized to meet the Marine Corps GPS Manpack requirements, it will be employed by infantry regiments, artillery battalions, radio battalions, air and naval gunfire liaison companies (ANGLICO), topographical companies, and Marine aircraft wing units as necessary to complement and augment the Position Location Reporting System (PLRS). Minimum quantities projected for the reconnaissance organizations are: 18 per force reconnaissance company and 32 per reconnaissance battalion. This results in a total of 200 SUNS required to equip the active and reserve reconnaissance elements. (It is emphasized that the above quantities are minimum amounts necessary to meet only the FMF reconnaissance requirements. The quantities required for PWR and MPS, as well as the distribution within other FMF units, will be subsequently determined through refinement of the Marine Corps Communication Navigation Identification (CNI) Architecture.)

4. ESSENTIAL CHARACTERISTICS

a. Size. The SUNS shall be no larger than 48 in³ (787 cm³) including control display unit, internal antenna, and battery. No individual dimension shall exceed 2" x 4" x 6" (5.1cm x 10.2cm x 15.2cm). If an external/remote antenna is required, the total volume of the SUNS shall not exceed 92 in³ (1500 cm³).

b. Weight. No more than 4 lbs (1.81 kg) including batteries, antenna, and attachment devices.

c. Controls and Information Displays. Must be compatible with night vision devices and must not appreciably degrade an individual's night vision. Must be usable by a person wearing an oxygen mask or field protective mask. All positional data must be available in terms of geodetic latitude and longitude, 12-character Military Grid Reference System (MGRS) coordinates, Universal Transverse Mercator or Universal Polar Stereographic. WGS-72 or an approved DOD local datum shall be used as referenced datum.

(1) Controls must include:

(a) System power on/off.

(b) Standby.

(c) A means to input data such as: Current position, final destinations, and at least three intermediate way points.

(d) A means to request data and control displays.

(2) Information must be displayed within 30 seconds of query and must include:

(a) Steering information for a course which will provide minimum miss distance from desired destination.

(b) Bearing to destination.

(c) Horizontal distance to destination.

(d) Current position.

(e) Current ground speed and course.

(f) Height above/below way point or destination .

(g) Coordinated Universal Time (CUT) hr, min, sec.

d. Durability. Must be able to withstand:

(1) An overall system life of 10,000 hours.

(2) Shock created by a parachute opening (worst case estimate is a force of 8 G's in one second).

(3) Shock and vibration found in a small inflatable boat doing 25 knots in a sea state 3.

(4) Immersion in sea water at a depth of 30 feet for 2 hours. Immersion in sea water at a depth of 120 feet for 30 minutes. A pressure-resistant vessel may be used for the 120-foot depth.

(5) Pressure equivalence of 35,000 ft above MSL while operating.

(6) Temperature extremes of:

(a) -80°F (-62°C) for 10 minutes.

(b) -40°F (-51°C) to + 130°F (+63°C) during normal continuous operation. (For temperatures below -20°F (-29°C) auxiliary means of providing required heat may be considered and not be counted in the maximum size and weight requirements listed previously.)

e. Accuracy. Must provide minimum position accuracy of 50 meters Spherical Error Probability (SEP) while mobile and 10 meters SEP while stationary.

f. Nuclear Survivability. Nuclear survivability is not required; however, protection from electromagnetic pulse is desired.

g. Reliability. Mean Time Between Failure (MTBF) of 2,500 hours.

h. Mean Corrective Time (MCT) of five minutes to replace batteries.

i. Battery Life. Batteries of existing design to provide 18 hours of continuous use as follows:

(1) Continuous steering information display for 10 hours.

(2) All other information called up four times per hour for 18 hours.

j. Counter-Measures. Must be resistant to jamming, meaconing and interference.

k. Maintenance Concept. SUNS shall be designed for ease of testing on Automatic Test Equipment (ATE). No special purpose test equipment will be required for SUNS maintenance.

(1) Maintenance will be accomplished at the lowest level, as far forward in the battle area as possible.

(2) The system design will promote inexpensive throwaway parts, standardization, and modular design to simplify or enhance maintenance efficiency and operational readiness where possible.

(3) Current maintenance personnel skills will receive maximum use.

(4) Reliability Centered Maintenance (RCM) will be fundamental to the system design.

(5) Excessive contractor support, highly complex test equipment, extensive maintenance facilities, and other logistics factors will be minimized.

5. INTRA/INTEROPERABILITY AND STANDARDIZATION REQUIREMENTS

a. The SUNS is envisioned as a Product Improvement to the NAVSTAR GPS User Equipment (UE) Segment. As such, the SUNS may require an interface connector to facilitate electronic transfer

of the SUNS derived GPS information to other equipment or systems. As specific requirements are identified, technical interface specifications will be developed for each equipment item or system to be interfaced.

6. RELATED EFFORTS

a. ROC No. CCC 1.34, GLOBAL POSITIONING SYSTEM (GPS)
(Relationship described in paragraph 5 above).

b. ROC No. CCC 0.01, POSITION LOCATING REPORTING SYSTEM (PLRS).

c. Defense Advance Research Projects Agency (DARPA), GPS Receiver Miniaturization Program. This program was initiated in May 1983 with the objective of developing and fabricating a set of Very Large Scale Integrated (VLSI) chips to be utilized in fabrication of a 100 cm³ GPS receiver for feasibility demonstration by January 1986. This substantially reduces the risks and costs for SUNS development since Defense Advanced Research Projects Agency has agreed to tailor the design of the VLSI chips set to meet SUNS requirements. Additionally, DARPA has agreed to provide chip sets, at no cost, to the SUNS program for the fabrication of Engineering Development Model (EDM) sets.

7. TECHNICAL FEASIBILITY, COST FORECAST AND ENERGY/ENVIRONMENTAL IMPACTS (\$000 FY84)

a. Feasibility. The capability described in the ROC is within the state of the art and is considered technically feasible.

b. Costs. DARPA has currently budgeted \$16.5M for system design and technology development leading to the fabrication of chip sets to be used in their 100 cm³ demonstrator and in the SUNS EDM sets. Estimated Marine Corps RDT&E and PMC costs are:

	FY84	FY85	FY86	FY87	FY88	FY89
RDT&E	374K	780K	1500K	1400K	500K	100K
PMC	-	-	-	-	(100)1500K	(100)1500K

c. Production unit costs are estimated at \$10-15K each for a low volume procurement (500-1000 units).

d. Operation/support cost forecasts are not available; however, these costs are expected to be minimal due to the small number of Lowest Replaceable Units (LRU).

e. SUNS is not an energy intensive system. The highly accurate position information that is provided will reduce energy

consumption through more efficient operation. No energy intensive materials will be used in the SUNS program.

8. MANPOWER REQUIREMENTS

a. No additional manpower numbers, skills or grades are required for operation of this system.

9. TRAINING REQUIREMENTS

a. Operator training will require no formal school and can be conducted at the user unit level.

b. Formal training for the maintenance personnel will be required; however, it appears that the impact will be minimal for the organizational and intermediate levels of repair, while depot level repair may require contractor support.

c. Training simulators will not be required.

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